Faunitaxys

Revue de Faunistique, Taxonomie et Systématique morphologique et moléculaire

Volume 13
Numéro 09

Février 2025

ISSN (Print) : 2269 - 6016
ISSN (Online) : 2970 - 4960
Dépôt légal : Février 2025

Faunitaxys

Revue de Faunistique, Taxonomie et Systématique morphologique et moléculaire

ZooBank : https://zoobank.org/79A36B2E-F645-4F9A-AE2B-ED32CE6771CC

Directeur de la publication, rédacteur, conception graphique et PAO:
Lionel Delaunay

Cette revue ne peut pas être vendue
Elle est distribuée par échange aux institutions (version papier)
et sur simple demande aux particuliers (format PDF)
à l'adresse suivante:

AFCFF (Association française de Cartographie de la Faune et de la Flore)
28, rue Voltaire, F- 42100 Saint Etienne
E-mail: faunitaxys.journal@gmail.com

Elle est disponible librement au téléchargement à partir du site:

https://faunitaxys.fr/

La parution de *Faunitaxys* est apériodique

Faunitaxys est indexé dans / ***Faunitaxys*** is indexed in:
- Zoological Record
Articles and nomenclatural novelties are referenced by:
- ZooBank (https://zoobank.org)
Online Archives:
- HAL (https://hal.archives-ouvertes.fr)
- Internet Archive (https://archive.org/details/faunitaxys)

Imprimée sur les presses de SPEED COPIE, 6, rue Tréfilerie, F- 42100 Saint-Etienne

Imprimé le 17 02 2025

https://doi.org/10.57800/faunitaxys-13(09)

A world list of known cave- and bat guano-associated Trogidae (Coleoptera: Scarabaeoidea), and further range extension of *Omorgus lindemannae* (Petrovitz)

WERNER P. STRÜMPHER (1) & RIAAN STALS (2, *)

(1) Ditsong National Museum of Natural History, PO Box 413, Pretoria 0001, South Africa. - E-mail: strumpher@ditsong.org.za - Orcid: https://orcid.org/0000-0002-7047-2666 - ZooBank: https://zoobank.org/9F2BDEDC-92F8-4F2A-964E-7EC1EE430B37

(2) South African National Collection of Insects, Agricultural Research Council, Roodeplaat, Pretoria, South Africa. - E-mail: StalsR@arc.agric.za - Orcid: https://orcid.org/0000-0003-0369-8822 - ZooBank: https://zoobank.org/9f787963-846c-4ce3-a141-bd047e072545

* Corresponding author

Keywords:

Coleoptera; Scarabaeoidea; Trogidae; *Trox*; *Phoberus*; *Afromorgus*; *Haroldomorgus*; *Polynoncus*; Chiroptera; cavernicolous; tree hollow; distribution; new record; keratin beetle.

Abstract. – Trogidae are not uncommonly associated with guano deposits derived from cave-roosting bats, and less commonly with bat guano in tree hollows. Trogidae may also occur in caves without any apparent association with bat guano. Since a rather large number of reports of the foregoing behaviour is scattered through an often obscure literature, we compiled and commented on a list of Trogidae species—worldwide—that have been recorded either from caves, or from bat guano inside or outside of caves. We report on 20 named species confirmed to be cavernicolous and/or associated with bat excrement; and on an unknowable number of species hitherto identified only to genus level. We tabulate possibly cavernicolous species for which confirmation of a cave association is required. We consider the presence in caves of half of these named species as accidental or incidental, 9 or 10 species as troglophilic, and three species as both troglophilic and bat-guanophilic. One species appears not to be a troglophile, but still a bat-guanobiont; this may be a novel life history style. No Trogidae is known to be troglomorphic or troglobitic. For three named species we present the first published evidence of a putatively cavernicolous life style. We propose that *Trox perrisii* Fairmaire be excluded from a compilation such as ours. We introduce our work with a critical overview of Trogidae feeding habits: they do not necessarily feed on keratinous material, as is widely assumed. We report new southern African localities that extend the range of *Omorgus lindemannae* (Petrovitz). Colour photos of each of the listed genera and subgenera accompany the text.

Strümpher W. P. & Stals R., 2025. – A world list of known cave- and bat guano-associated Trogidae (Coleoptera: Scarabaeoidea), and further range extension of *Omorgus lindemannae* (Petrovitz). *Faunitaxys*, 13(09): 1 – 11.

DOI: https://doi.org/10.57800/faunitaxys-13(09)

ZooBank: https://zoobank.org/F1BD81DF-701C-4C72-9ECE-BADB5679470F

Received: 27/10/2024 – *Revised*: 02/02/2025 – *Accepted*: 03/02/2025

Introduction

Adults and larvae of all species of Trogidae may be found associated with virtually any animal remains (carcasses and shed, remnant or excreted material); such remains are usually in a late stage of decomposition (e.g. Braack, 1986; Horenstein & Linhares, 2011; Kočárek, 2003; Payne & Crossley, 1966; Scholtz & Caveney, 1992; Strümpher et al., 2014a; Zunino, 1991). All Trogidae—both as adults and as larvae—seem to have the ability to digest keratin (Hughes & Vogler, 2006; Scholtz, 1986a; Scholtz & Chown, 1995; Sugiura & Ikeda, 2014). Despite their preference for carcasses and carrion, trogids will also opportunistically feed on a range of other animal-derived foodstuffs, mostly dead, but at times also living. Such opportunistic food sources include—on the one hand—organic material with assumed high keratin content, like the faeces of carnivorous mammals (e.g. Gómez et al., 2022; Jackson & Diéguez, 2023; Krell et al., 2003; Moctezuma & Halffter, 2022; Stals, personal observations; Strümpher, personal observations; Tocco et al., 2018) and the regurgitated pellets of owls and other birds of prey (Hicks, 1959; Majka et al., 2006; Scholtz, 1980; Strümpher, personal observations), all of which usually contain undigested feathers, hairs, scales or other keratinous body parts of erstwhile prey. On the other hand, Trogidae liberally also consume a variety of food resources that can be assumed not to contain notable amounts of keratin. Principal recorded examples thereof are locust eggs (Baker, 1968; Risbec, 1946; Roffey, 1958; Van Emden, 1948, Peck, 2009), fly maggots (Scholtz, 1980, 1986b), soil-dwelling arthropods, especially ants and termites (Houston et al., 2010), dead insects (Young, 2006; Young & Hamm, 1985), eggs of sea turtles and land iguanas (e.g. Allgöwer, 1980, 1981; Baena et al., 2015; Rosano-Hernández & Deloya, 2002), poultry manure (Gianizella & Prado, 1999; Lopes et al., 2007), and bat guano (e.g. Chapman, 1983; Correa et al., 2022; Ferreira & Martins, 1999; Leefmans, 1932; Scholtz, 1986b). In many habitats, these food sources could be more readily available and more dependable sources of food than carrion which, generally, can be considered ephemeral (but see Scholtz & Caveney, 1988 about mummified remains of large antelope remaining

Reviewer:

Jean-Bernard Huchet (*ISYEB, UMR 7205, Muséum national d'Histoire naturelle, Paris*) - https://zoobank.org/Authors/AD63F3ED-5BCD-499C-8A10-DD29EA962CA4 - https://orcid.org/0000-0002-3906-6934

This is an open access article under the terms of the Creative Commons Attribution-NonCommercial-NoDerivs License, which permits use and distribution in any medium, provided the original work is properly cited, the use is non-commercial and no modifications or adaptations are made. **Copyright 2025**. The Authors. *Faunitaxys* published by Lionel Delaunay on behalf of the AFCFF (Association française de Cartographie de la Faune et de la Flore).

available for years). It is hence not implausible that trogids will scavenge or utilise these food sources during periods when carcasses or carrion are scarce.

At least some trogid beetle species may also exploit these alternative food sources for breeding and larval development. Leefmans (1932) was the first to document Trogidae feeding on and breeding in bat guano. He reported *Omorgus* (*Omorgus*) *costatus* Wiedemann, 1823, from a cave in Celebes (now Sulawesi, Indonesia). In addition, Leefmans (1932) demonstrated through a series of breeding experiments that *Omorgus costatus* can be successfully reared on fresh bat guano, dead insects, or a mixture of both. Chapman (1983) recorded a large number of *Omorgus costatus* in the guano deposits below a large bat roost in a cave in the Gunung Mulu National Park, on the island Borneo in the State of Sarawak, Malaysia. Blair (1929) and McClure et al. (1967) recorded adults, pupae and larvae of *Omorgus costatus* in guano from the Batu Caves near Kuala Lumpur, Malaysia. *Omorgus costatus* is widespread throughout Australasia; collection records show that the species is often collected in caves (Scholtz, 1986b). The foregoing could indicate that *Omorgus costatus* may have a close—or at least regular—association with caves and with bat guano. Within caves, trogid beetles (larvae and adults) appear to be associated with older guano deposits beneath large bat roosts (Chapman, 1983; Leefmans, 1932). Different trogid beetle species have been collected from guano piles of frugivorous (e.g. Leefmans, 1932), insectivorous (e.g. Chapman, 1983; Leefmans, 1932) and haematophagous bats (Ferreira & Martins, 1999).

Bats play an integral role in the functioning and maintenance of many cave ecosystems, either directly or indirectly through the production and deposition of guano. Bats are the principal source of organic matter in cave ecosystems, along with cave-roosting birds. Many cave-dwelling invertebrates, certain vertebrates, and various higher taxa of microorganisms are wholly dependent on bats to provide nutrients via their guano (e.g. Ferreira & Martins, 1999; Gnaspini & Trajano, 2000; Kunz et al., 2011; Ramírez-Fráncel et al., 2022; Sharratt et al., 2000). Guano and dead bats (e.g. Braack, 1989) that accumulate in caves could present an important and readily available source of food for Trogidae.

To date, twenty named trogid species have been recorded from bat guano in caves, or collected in caves, or from bat guano in hollow trees where bats aggregate or roost. These reports provide evidence that several trogid species are associated, at least sporadically, with bat guano and that a cavernicolous lifestyle may be more widespread in the family than presently known. As always, more research is required to fully understand the extent of the actual association of Trogidae with caves and with bat guano.

Material and methods

We compiled a list of Trogidae associated with bat guano in caves, with bat guano in tree hollows, and found in caves regardless of whether an association with bat guano had been recorded or not. Our list is based is on existing literature, both peer-reviewed and grey. The scope is global.

We searched for additional, unpublished records of Trogidae collected in caves or tree hollows in two large beetle collections, relying on existing label data. These collections are those of the Ditsong National Museum of Natural History and the South African National Collection of Insects, both in Pretoria, South Africa. Suitable specimens were discovered in both collections. We added some detail and explanatory notes for the Afrotropical species on our list, based on new findings by the first author and the memory of the second author.

Abbreviations of specimen depositories

– **SANC**: South African National Collection of Insects, Pretoria, South Africa.
– **TMSA**: Ditsong National Museum of Natural History, Pretoria, South Africa.

Place names in the world list refer only to political divisions from where records originated; they do not reflect the entire known distribution of any species. Our terminology of the environmental zonation of caves and of the various types of cavernicolous life styles and adaptations follows, respectively, those of Howarth & Moldovan (2018) and Deharveng & Bedos (2018). Label data are presented in a standardised format with place names updated to the currently valid names, spelling and orthography.

Results and discussion

Below we present a world list of Trogidae species collected from bat guano in caves and tree hollows, or from caves but without an indication of an association with bat guano. We report on 20 named species confirmed to be cavernicolous and/or associated with bat excrement, and on an unknowable number of species hitherto identified only to genus level. We evaluated the published evidence for each species to establish whether it qualifies as cavernicolous and troglophilic, and whether it is really associated with bat excrement. This information is summarised in Table 1. Half of the named cavernicolous species are accidental or incidental, a similar number are troglophiles, and three species are bat-guanophiles besides also being troglophilic. *Omorgus mollis* (Arrow, 1927) appears not to be a troglophile, but still a bat-guanobiont—the only guanobiont recognised among the species investigated. It seems to be exclusively associated with bat guano in tree hollows, which may be a novel life history style. No Trogidae is known to possess troglomorphic adaptations, and we do not anticipate the discovery of such beetles. Inasmuch, we could not find evidence for any Trogidae being troglobitic.

We list five possibly cavernicolous species for which confirmation of a cave association is required (Table 2). These are species with label data reported in the literature, or newly detected by us, where only the name of a cave is given as the collecting locality, without additional ecobiological notes. In such cases it is unknown whether a specimen was found inside a cave or cave complex, or just in its vicinity, outside the cave itself.

We propose that *Trox perrisii* Fairmaire be excluded from a compilation such as ours. We believe that the literature records which denoted this species as associated with bat guano are erroneous, besides which this species lives in bird nests and in hollows with roosting birds: it is not a troglophile nor a bat-guanophile, but a bird-guanophile or even bird-guanobiont.

For *Omorgus lindemannae* (Petrovitz) we report new southern African localities that extend the range of this apparently very rare species, described from Tanzania, to north-western Botswana and the KwaZulu-Natal province of South Africa. For three trogid species—two from South Africa and one from India—we publish the first records of an association with caves and/or with bat guano.

We present this list with warts and all, limited by an incomplete literature that contains many ambiguous and vague reports of habitat and interspecies associations. We hope that this compilation will encourage scientists, collectors and observers working inside caves to develop an eye for Trogidae and record them and their exact circumstances. Our list is—necessarily—preliminary; it will most likely expand as cave exploration, insect collecting and field documentation continue.

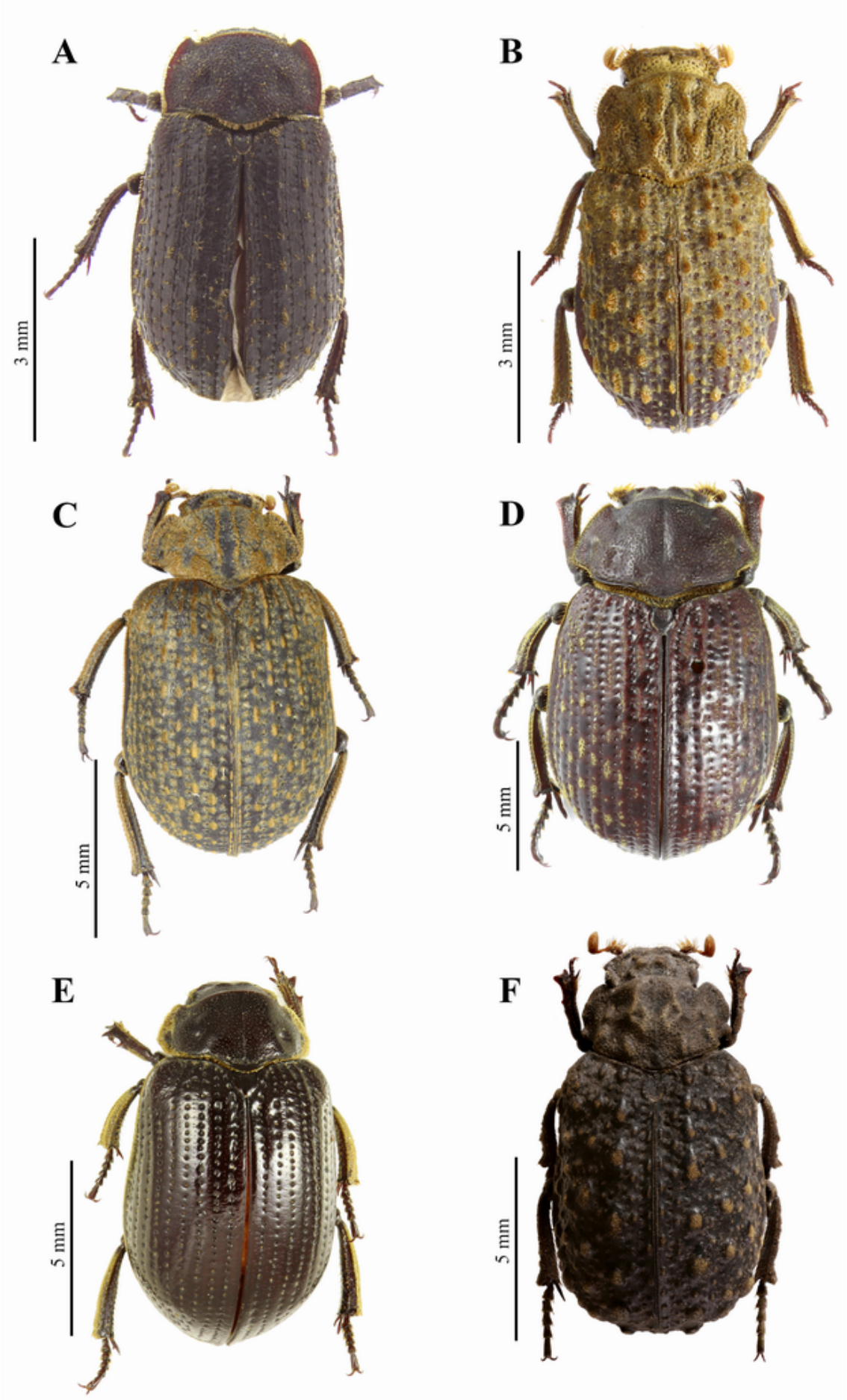

Fig. **1**. Selected Trogidae reported from caves and / or bat guano. Adults, non-types, dorsal.

A. *Trox scaber* (Linnaeus, 1767). **B**. *Phoberus pusillus* (Péringuey, 1908). **C**. *Omorgus* (*Omorgus*) *costatus* (Wiedemann, 1823). **D**. *Omorgus* (*Afromorgus*) *lindemannae* (Petrovitz, 1975). **E**. *Omorgus* (*Haroldomorgus*) *batesi* (Harold, 1872). **F**. *Polynoncus gemmingeri* (Harold, 1872).

Trogidae collected from bat guano in caves or in hollow trees, or from caves

Family **Trogidae** MacLeay, 1819

Subfamily **Troginae** MacLeay, 1819

Genus ***Trox*** Fabricius, 1775

Trox aequalis Say, 1832

UNITED STATES OF AMERICA: GEORGIA. The species was reported to "*apparently live*" in bat guano in a cave (Reeves et al., 2000: 175). Slay et al. (2012) considered this to be an accidental collection since there is only this single record from a cave. *Trox aequalis*, widespread through the Nearctic Region, is usually associated with nests of various mammals and birds (Vaurie, 1955) and not with caves or guano, supporting the contention of Slay et al. (2012).

Trox laticollis LeConte, 1854

UNITED STATES OF AMERICA: IOWA, ARKANSAS. This scarce American species is almost exclusively found in fox burrows (Robinson, 1941; Vaurie, 1955). Peck & Christiansen (1990) presented a single record from a cave, themselves denoting it as an accidental collection, something with which Slay et al. (2012) agreed. Robinson (1941) reported four individuals of *Trox laticollis* which were feeding on a dead fox in a cave; we suspect that the common denominator is the fox, and not the cave.

Trox scaber (Linnaeus, 1767)
(Fig. 1A)

SPAIN; UNITED STATES OF AMERICA: MISSOURI. This widepread Palaearctic species has spread to the New World and to Australasia (Pittino & Bezděk, 2016); it has been denoted as subcosmopolitan, among others by Zidek (2013). Besides feeding on animal carcasses, this species is often found in various bird and mammal nests and burrows (e.g. Vaurie, 1955; Hicks, 1959). *Trox scaber* has been recorded from caves in both Western Europe and North America (Gardner, 1986; Tinaut et al., 2008; Pérez et al., 2011). We call into question the categorisation by Slay et al. (2012) of this species being only accidentally in caves; these authors overlooked the reports from Europe.

Trox sp. indet.

UNITED STATES OF AMERICA: TEXAS. One dead specimen was found buried in guano in a cave (Crawford & Veni, 1981). Further comment is impossible without a species-level identification.

Genus ***Phoberus*** MacLeay, 1819

Phoberus capensis (Scholtz, 1979) / ***Phoberus nasutus*** (Harold, 1872)

This identification is ambiguous. Sharratt et al. (2000: 142) presented the identification in the format we maintain above, albeit that both species names were combined with the genus name *Trox* Fabricius. Sebastian Endrödy-Younga, then of the TMSA, made the identification in 1998, but voucher specimens could not be traced in the TMSA beetle collection. *Phoberus capensis* and *Phoberus nasutus* are morphologically similar to each other, shown to be sister species by Strümpher et al. (2014b).
SOUTH AFRICA: WESTERN CAPE. Specimens were collected in the dark zone of the Table Mountain caves on the Cape Peninsula. Microchiropteran bats were present throughout the dark zone of the cave where the beetles were collected (Sharratt et al., 2000). We interpret this as an incidental occurrence of the Trogidae in a cave.

Phoberus pusillus (Péringuey, 1908)
(Fig. 1B)

DEMOCRATIC REPUBLIC OF THE CONGO: HAUT-KATANGA. Scholtz (1980) reported an undisclosed number of *Phoberus pusillus* specimens from the Kakontwe and Mwanga Caves in the vicinity of Likasi. These beetles were collected by Narcisse Leleup (1912–2001), unrivalled collector of soil insects, but also a collector of bats in search of their ectoparasites (Van Cakenberghe et al., 2017). No fewer than 18 bat species have been recorded from these two caves, represented by both insect-feeders and fruit-eaters (Van Cakenberghe et al., 2017). We interpret this as that *Phoberus pusillus* is a troglophile, and probably a bat-guanophile.

Phoberus cf. ***sulcatus*** (Thunberg, 1787)

The identity of the single specimen here reported is unclear. The preliminary identification above was in 2006 made by Riaan Stals of the SANC, but as '*Trox* sp. cf. *sulcatus* Thunberg.' No voucher specimen could be tracked down in the SANC, probably having been returned to the student from whose project the specimen originated. Current research shows that this beetle could not have been "true" *Phoberus sulcatus*, which is now known not to occur even close to the region where this beetle was captured (Strümpher et al., in preparation).
SOUTH AFRICA: GAUTENG. A specimen was collected in sand near bat guano in a cave of the Cradle of Humankind World Heritage Site (Marais & Durand 2006). For the time being, we consider this an incidental occurrence.
New record of a trogid species in a cave and possibly associated with bat guano.

Subfamily **Omorginae** Nikolajev, 2005

Genus ***Omorgus*** Erichson, 1847

Subgenus ***Omorgus*** (***Omorgus***) Erichson, 1847

Omorgus alatus (Macleay, 1888)

AUSTRALIA: WESTERN AUSTRALIA, NORTHERN TERRITORY. There are records from various caves (Moulds, 2004; Scholtz, 1986b). Four of the seven *Omorgus alatus* specimens available to Scholtz (1986b) originated from caves or rock shelters, leading him to speculate that this species may have adapted to life in sheltered situations, thus relieving the beetles from the necessity to burrow into soil for protection. Hamilton-Smith et al. (1989: 20) concluded that this "*extremely rare*" species seems to be "*more or less confined to cave environments*," while Moulds (2004) classified it as a troglophile and perhaps a guanophile.

Omorgus amictus (Haaf, 1954)

AUSTRALIA: WESTERN AUSTRALIA, SOUTH AUSTRALIA. *Omorgus amictus* has only been recorded from the Nullarbor Plain in southern Australia (Scholtz, 1986b), from where are numerous records from various caves (Moulds, 2004; Richards, 1971; Scholtz, 1986b). It has been collected from both the entrance zone and the dark zone of mostly shallow caves, but the species has also been taken from the soil surface and from rabbit warrens (Richards, 1971). Richards (1971) found that *Omorgus amictus* is in caves associated with bird guano, but not with bat guano. Outside caves, it has also been found on carcasses and skins. Since they can survive equally on the surface and in caves, it should be considered a troglophile (Moulds, 2004; Richards, 1971). Since its association with bird (not bat) guano is facultative, it is also categorised as a (bird-) guanophile (Moulds, 2004).

Omorgus brucki (Harold, 1872)

AUSTRALIA: QUEENSLAND, NEW SOUTH WALES. Scholtz (1986b: 35) reported that this species "*is frequently taken in caves.*" It may hence indeed be a troglophile; no other relevant information exists.

Omorgus carinatus (Loomis, 1922)

UNITED STATES OF AMERICA: NEW MEXICO. Vaurie (1955) reported a specimen of *Omorgus carinatus* from 'Carlsbad Cavern,' but from only the reported label data it is impossible to tell whether that specimen was collected inside the cave system itself, or from the wider Carlsbad Caverns National Park. Cokendolpher & Polyak (1996: 190) reported a single individual from the "*twilight/dark junction*" of a cave. *Omorgus carinatus* appears to be associated with nests or middens of woodrats (*Neotoma* Say & Ord, Cricetidae) (Loomis, 1922; Slay et al., 2012), while woodrats are commonly found in caves (e.g. Tweet et al., 2012). The foregoing facts lead Slay et al. (2012) to categorise the presence of this beetle species in a cave to be accidental.

Omorgus costatus (Wiedemann, 1823)
(Fig. 1C)

AUSTRALIA; INDONESIA; MALAYSIA. This species is widespread through the Oriental and Australasian Regions (Scholtz, 1986b; Strümpher & Kalawate, 2023). It is often encountered in caves, where it has repeatedly been recorded feeding on, burrowing into, and breeding in bat guano (Blair, 1929; Chapman, 1983; Leefmans, 1932; McClure et al., 1967; Moulds, 2004; Scholtz, 1986b). McClure et al. (1967) reported that adults, larvae and pupae of the species lived inside the guano of a Malaysian cave and was rarely seen on the surface. Arrow (1927) additionally reported that *Omorgus costatus* was collected from bat guano in hollow trees in Malaysia. Moulds (2004) categorised this trogid species as a troglophile and possibly a guanophile; we confirm here that the species is indeed bat-guanophilic, since narrow associations with bat guano have been observed repeatedly.

Omorgus fuliginosus (Robinson, 1941)

MEXICO: MORELOS. Muñiz Vélez (2001) reported fragments of one specimen of *Omorgus fuliginosus* from an archaeological site inside a cave. We consider this to be an incidental occurrence.

Omorgus mollis (Arrow, 1927)

MALAYSIA; INDONESIA. All specimens of *Omorgus mollis* available or known to Scholtz (1986b) were collected in bat guano in hollow trees. If this observational pattern persists, *Omorgus mollis* may uniquely be a non-cavernicolous bat-guanobiont. Presently this seems to be an unlikely life history style—more field observations and collecting of this rare species are required, as well as an open mind that Nature contains secrets which are unlikely but—in fact—true.

Omorgus punctatus (Germar, 1823)

UNITED STATES OF AMERICA: CALIFORNIA. A single specimen was trapped near an entrance to a cave (Aalbu, 1990). Aalbu (1990: 9) considered this an "*accidental cavernicolous*" beetle. Slay et al. (2012) overlooked this report.

Omorgus rubricans (Robinson, 1946)

MEXICO: MORELOS. Muñiz Vélez (2001) reported fragments of one specimen of *Omorgus rubricans* from an archaeological site inside a cave. We consider this to be an incidental occurrence.

Omorgus suberosus (Fabricius, 1775)

UNITED STATES OF AMERICA: TEXAS; BRAZIL: TOCANTINS. *Omorgus suberosus* is an abundant, generalist species, ubiquitous throughout the New World (Vaurie, 1962), and adventive and widespread in Australasia, Oceania and the Oriental Region (Cartwright & Gordon, 1971; Miquel, 2019; Scholtz, 1986b). Specimens were collected in two Texan caves, in one of the caves on bat guano (Kohls and Jellison, 1948). Slay et al. (2012: 196) considered these to be "*accidental collections*." Muñiz Vélez (2001) reported fragments of several *Omorgus suberosus* individuals from an archaeological site inside a Mexican cave, while Costa-Silva et al. (2021) reported a specimen, bearing a label with the locality 'Casa de Pedra Cave,' in central Brazil, but without ecobiological remarks. We consider these also to be incidental occurrences.

Omorgus sp. indet., near ***Omorgus costatus*** (Wiedemann, 1823)

INDIA: MAHARASHTRA. A single specimen was collected from bat guano inside a subterranean cave in the northern Western Ghats, in which several thousand frugivorous and insectivorous bats aggregate (unpublished record, Aparna S. Kalawate, personal communication). This *Omorgus* species may be an undescribed species, but highly similar to *Omorgus costatus* (Kalawate, personal communication). Dr Kalawate is pursuing the identification of this beetle, or will newly describe it if it is a new species. We consider this to be an accidental collection. **Depending on its identity, possibly a new record of a trogid species in a cave and associated with bat guano. First published record of this phenomenon for India.**

Omorgus sp. indet.

AUSTRALIA: NORTHERN TERRITORY. Moulds & Bannink (2012) reported an unspecified number of this unidentified species collected in the transition zone of a karst cave (i.e. in the region of total darkness — Howarth & Moldovan, 2018). Informed comment is difficult without a species-level identification, but this record is notable therein that the Trogidae originated from the dark zone.

Omorgus sp. indet.

MEXICO: COAHUILA. Huchet et al. (2013) reported fragments of an unidentified *Omorgus* species recovered from a pre-Columbian funeral bundle in the Candelaria Cave, a mortuary cave. In an archaeological context, the presence of the beetle fragments in the funeral bundle would imply a period during which the corpse was accessible to colonisation by insects, and hence unburied (Huchet et al., 2013). These authors speculated that "[*I*]*n all likelihood, the colonization took place during the dry decay stage, the insects attracted by desiccated skin and ligaments*" (p. 286). In line with our argumentation elsewhere in this paper, we consider this to be an accidenal visitor to a cave.

Trox sp(p). and/or ***Omorgus*** sp(p). indet. (reported as *Trox* spp.).

AUSTRALIA: NORTHERN TERRITORY, QUEENSLAND, NEW SOUTH WALES. Numerous records of unidentified Trogidae exist in the literature: from various, but mostly unspecified, caves, including 'guano caves' and 'bat caves' (Moulds, 2004), and from bat guano deposits in caves (Hamilton-Smith, 1967). These species may include troglophiles and bat-guanophiles (Moulds, 2004), but in the absence of species-level identifications, and in the absence of better field notes, these records are only an indication of a larger cavernicolous trogid fauna than what we list here.

Genus ***Omorgus*** Erichson, 1847

Subgenus ***Omorgus*** (***Afromorgus***) Scholtz, 1986

Omorgus lindemannae (Petrovitz, 1975)
(Fig. 1D)

= *Trox* (*Omorgus*) *glaber* Scholtz, 1980, junior objective synonym (Pittino, 2005).

We discovered seven previously undetected specimens of *Omorgus lindemannae* in the TMSA and the SANC, five of which were collected in two distantly separated caves during four separate collecting events. Four specimens were collected in the Lanner Gorge Cave, South Africa, and one specimen in the Gcwihaba Cave, Botswana. The Lanner Gorge Cave and its fauna were characterised by Braack (1989) and is discussed under *Omorgus zumpti* below. The Gcwihaba Cave is home to at least three species of insectivorous bats with a total population of ca. 30,000–90,000 individuals (Dandurand et al., 2019; Seamark & Pretorius, 2018). The bats are responsible for a thick deposit of guano (Dandurand et al., 2019). Mazebedi & Hesselberg (2020) presented the results of a survey of the Gcwihaba Cave's terrestrial macroinvertebrates, but they did not report any Trogidae.

Omorgus lindemannae clearly is a troglophile. Its relation to guano has not yet been reported, but we cautiously suggest that it may be a bat-guanophile, based on the enormous deposits of bat guano in both these caves. Pittino (2005: 75) denoted *Omorgus lindemannae* to be a "*very rare species*."

These are new records of a trogid species in a cave and possibly associated with bat guano.

The collecting and other label data of the *Omorgus lindemannae* museum specimens discovered by us are presented below. The first four entries represent the five cave specimens. The entries as a whole define a further range extension of this trogid (e.g. Frey, 2009). Ever since its two descriptions (Petrovitz, 1975; Scholtz, 1980, as synonym), this species had been known only from two localities in south-central Tanzania (Lindi and Rukwa Regions), one specimen from each locality. Pittino (2005) reported the next known specimen, from the Limpopo province of South Africa, which represented a huge range extension. Our newly detected specimens further extend the known distribution of *Omorgus lindemannae* to Botswana and to the KwaZulu-Natal province of South Africa.

BOTSWANA

North West District
– **1** ♀ Gcwihaba Cave [as "Drotsky's Cave"], -20.024°, 21.354°, 1969-10-03, W Haacke & O Prozesky || *Trox zumpti* Haaf, det. CH Scholtz, 1980 (TMSA). — Misidentified as *Omorgus zumpti* by Scholtz (1980: 36).

New country record.

SOUTH AFRICA

Limpopo
– **1** ♂ Kruger National Park, Luvuvhu River, Lanner Gorge Cave [as "Cave N2, Pafuri"], ca. -22.450°, 31.150°, 1983-08-29, L Braack (TMSA).
– **1** ♂ Kruger National Park, Luvuvhu River, Lanner Gorge Cave [as "Lanner Gorge, Cave N2"], ca. -22.450°, 31.150°, 1983-09-26, L Braack (SANC).
– **2** ♀ Kruger National Park, Luvuvhu River, Lanner Gorge Cave [as "Pafuri cave"], ca. -22.450°, 31.150°, 1993-12, CH Scholtz (TMSA).

Mpumalanga
– **1** ♀ Kruger National Park, Skukuza, -25.00°, 31.59°, 1995-02-25, UV light trap, S Endrödy-Younga (TMSA).

New provincial record.

KwaZulu-Natal
– **1** ♀ Ndumo Game Reserve, ca. -26.87°, 32.25° [centroid], 1960-12, G van Son || *Trox zumpti* Haaf, det. CH Scholtz, 1980 (TMSA). — Misidentified as *Omorgus zumpti* by Scholtz (1980: 36).

New provincial record.

Omorgus zumpti (Haaf, 1957)

We have reason to be cautious that the Trogidae in Lanner Gorge Cave (see below) had correctly been identified as *Omorgus zumpti*, as reported by Braack (1989). We could not track down any trogid voucher specimens from Braack's study. Rather, in both the TMSA and the SANC we found four Lanner Gorge Cave specimens—resultant from three separate collection events—which are *Omorgus lindemannae*; their collecting details are presented above. We hence propose that Braack's (1989) beetles may rather have been *Omorgus lindemannae*, or that both *Omorgus zumpti* and *Omorgus lindemannae* co-occur in Lanner Gorge Cave. We did not trace any specimens truly being *Omorgus zumpti* from Lanner Gorge Cave, but that species is present on the Nyandu Sandveld, only some 30 km from the cave (Scholtz, 1980).

Omorgus zumpti and *Omorgus lindemannae* are similar species (Scholtz, 1980). The Trogidae from Lanner Gorge Cave were in the period between August 1983 and March 1988 identified by trogid specialist Clarke H. Scholtz. At that stage, *Omorgus lindemannae* (Petrovitz, 1975) was known—under the synonymic name *Trox* (*Omorgus*) *glaber* Scholtz, 1980—from only Tanzania. The first record of *Omorgus lindemannae* outside Tanzania, and inside South Africa, was presented by Pittino (2005).

SOUTH AFRICA: LIMPOPO. Braack (1989) surveyed Lanner Gorge Cave, a remote cave in the far north of the Kruger National Park, and described its macro-arthropod fauna. He estimated that more than 2,400 adult individuals of *Omorgus zumpti* were simultaneously present on the cave floor, mostly in the twilight zone. This beetle species is widespread in southern Africa, but rarely collected (Scholtz, 1980). Lanner Gorge Cave is inhabited by a large, permanent colony of fruit bats, the entire cave floor being covered with bat guano, in its proximal half more than a metre deep (Braack, 1989). Despite the abundance of bat guano, Braack (1989) did not report any interaction between the Trogidae and the guano, but rather reported that adult beetles were on several occasions observed feeding on dead bats. He reported this circumstance both in his text and in a schematic representation of trophic interactions in the cave (his Figure 2). We consider it unlikely that the Trogidae would not feed on the abundance of bat excrement, hence we suggest that *Omorgus zumpti* perhaps indeed is bat-guanophilic, while clearly being a troglophile.

Genus ***Omorgus*** Erichson, 1847

Subgenus ***Omorgus*** (***Haroldomorgus***) Scholtz, 1986

Omorgus batesi (Harold, 1872)
(Fig. 1E)

BRAZIL: PARÁ. A number of specimens were collected from bat guano in a cave (Correa et al., 2022). In the opinion of Correa et al. (2022), this species may truly be associated with caves. We agree and consider *Omorgus batesi* as a troglophile and bat-guanophile.

Genus *Polynoncus* Burmeister, 1876

Polynoncus gemmingeri (Harold, 1872)
(Fig. 1F)

BRAZIL: MINAS GERAIS. Several specimens were sampled from bat guano in caves (Correa et al., 2022). Correa et al. (2022) found this species to have been the most abundant scarab species in their survey of Scarabaeoidea in Brazilian caves. They argued that this species may also be truly associated with caves, and suggested that the species may be classified as a troglophile. Necessarily it also seems to be bat-guanophilic.

Table 1. List of cavernicolous Trogidae species and/or Trogidae associated with bat guano, with classification of their association with caves and with bat guano.

Species	Accidental	Troglophile	Bat-guanophile	Bat-guanobiont
Omorgus* (*Afromorgus*) *lindemannae		YES	Probably	
Omorgus* (*Afromorgus*) *zumpti		YES	Perhaps	
Omorgus* (*Haroldomorgus*) *batesi		YES	YES	
Omorgus* (*Omorgus*) *alatus		YES	Perhaps	
Omorgus* (*Omorgus*) *amictus		YES	NO	
Omorgus* (*Omorgus*) *brucki		YES	Unknown	
Omorgus* (*Omorgus*) *carinatus	YES			
Omorgus* (*Omorgus*) *costatus		YES	YES	
Omorgus* (*Omorgus*) *fuliginosus	YES			
Omorgus* (*Omorgus*) *mollis		NO		YES
Omorgus* (*Omorgus*) *punctatus	YES			
Omorgus* (*Omorgus*) *rubricans	YES			
Omorgus* (*Omorgus*) *suberosus	YES			
Phoberus capensis* / *Phoberus nasutus	YES			
Phoberus pusillus		YES	Probably	
Phoberus* cf. *sulcatus	YES			
Polynoncus gemmingeri		YES	YES	
Trox aequalis	YES			
Trox laticollis	YES			
Trox scaber	Perhaps	Perhaps		

Table 2. List of Trogidae species with label data that is a cave name, but for which it is yet unknown whether the species was captured inside the cave or in the vicinity of the cave.

Species	Country and division	Collecting events	Source
Omorgus* (*Omorgus*) *augustae (Blackburn, 1892)	Australia: South Australia	1	Scholtz 1986b
Omorgus* (*Omorgus*) *dilaticollis (MacLeay, 1888)	Australia: Northern Territory, Queensland	2	Scholtz 1986b
Omorgus* (*Omorgus*) *euclensis (Blackburn, 1892)	Australia: Western Australia	1	Scholtz 1986b
Omorgus* (*Omorgus*) *inflatus (Loomis, 1922)	USA: Arizona, New Mexico	2	Vaurie 1955
Phoberus consimilis (Haaf, 1953)	South Africa: Northern Cape	1	SANC, unpublished

False record of a trogid species being associated with bat guano

Trox perrisii Fairmaire, 1868

AUSTRIA; FRANCE. Numerous instances of specimens from woodpecker nests secondarily occupied by starlings or "*bats*" [sic!] were reported by Petrovitz (1969: 104). From Petrovitz's short report it cannot confidently be concluded that the associated vertebrates were bats indeed: it may have been only birds, or both birds and bats. Byk et al. (2019) comprehensively reviewed the ecology of *Trox perrisii* without adding any information about this species being associated with either bats or caves, besides misinterpreting Petrovitz's (1969) report therein that they categorically stated that Petrovitz's woodpecker hollows were secondarily occupied by bats, not birds. We disagree that such a bat association can be confirmed from existing literature. Byk et al. (2019) confirmed that this beetle species inhabits the nests of several bird species, as well as hollows in trees, with or without bird inhabitants. *Trox nidicola* Bonnaire, 1881 is a junior synonym of *Trox perrisii*: the description of this nominal species was based on a small number of specimens found among debris in a bird nest in a tree hollow (Bonnaire, 1881). There is—in our view—no unambiguous evidence that *Trox perrisii* is associated either with caves or with bat guano. We suggest that *Trox perrisii* be deleted from the corpus of bat-guano-associated Trogidae. The species does seem to be bird-guano-associated. It is not a troglophile.

Acknowledgements

We thank Aparna Sureshchandra Kalawate of the Zoological Survey of India, Puṇē, Maharashtra, for communicating to us the discovery of the yet-unidentified *Omorgus* specimen from an Indian cave. We thank Jean-Bernard Huchet of the National Natural History Museum in Paris, France, for above-average commentary as reviewer of this contribution's manuscript. RS acknowledges Public Good funding from the South African Departments of Science and Innovation and of Agriculture, Land Reform and Rural Development.

References

Aalbu R.L., 1990 [1989]. – An analysis of the Coleoptera of Mitchell Caverns, San Bernardino County, California. *The NSS Bulletin. Journal of Caves and Karst Studies*, 51(1): 1 - 10.

Allgöwer K., 1980. – Effect of the scarab beetle *Trox suberosus* on the hatching success of the east Pacific green turtle *Chelonia mydas agassizi* in the Galapagos Islands. *Annual Report of the Charles Darwin Research Station, Galapagos, Ecuador*, 1979: 152 - 154.

Allgöwer K., 1981. – Egg predation on Galapagos reptiles by the scarabeid beetle *Trox suberosus*. *Annual Report of the Charles Darwin Research Station, Galapagos, Ecuador*, 1980: 70 - 71.

Arrow G.J., 1927. – A note on the coleopterous genus *Trox*, with descriptions of a few new Asiatic species. *Annals and Magazine of Natural History, Series 9*, 19(112): 465–468. https://doi.org/10.1080/00222932708655516.

Baena M.L., Escobar F., Halffter G. & García-Chávez J.H., 2015. – Distribution and feeding behavior of *Omorgus suberosus* (Coleoptera: Trogidae) in *Lepidochelys olivacea* turtle nests. *PLoS ONE*, 10(9), e0139538: 1 - 19. https://doi.org/10.1371/journal.pone.0139538.

Baker C.W., 1968. – Larval taxonomy of the Troginae in North America with notes on biologies and life histories (Coleoptera: Scarabaeoidea). *Bulletin of the United States National Museum*, 279: 1 - 79.

Blair K.G., 1929. – Fauna of the Batu Caves, Selangor. XVII. Coleoptera. *Journal of the Federated Malay States Museums*, 14: 381 - 387.

Bonnaire A., 1881. – [Untitled]. *Bulletin de la Société Entomologique de France*, 6(1): 63 - 64.

Braack L.E.O., 1986. – Arthropods associated with carcasses in the northern Kruger National Park. *South African Journal of Wildlife Research*, 16(3): 91 - 98. https://doi.org/10520/AJA03794369_2840.

Braack L.E.O., 1989. – Arthropod inhabitants of a tropical cave 'island' environment provisioned by bats. *Biological Conservation*, 48(2): 77-84. https://doi.org/10.1016/0006-3207(89)90027-X.

Byk A., Gazurek T. & Tylkowski S., 2019 – Keratin beetle *Trox perrisii* Fairmaire, 1868 (Coleoptera: Trogidae): first records for Greece and Poland, with a review of its distribution and ecology. *Acta Zoologica Bulgarica*, 71(1): 37 - 46.

Cartwright O.L. & Gordon R.D., 1971. – Coleoptera: Scarabaeidae. *Insects of Micronesia*, 17(4): 257 - 296.

Chapman P.R.J., 1983. – Species diversity in a tropical cave ecosystem. *Proceedings of the University of Bristol Spelaeological Society*, 16(3): 201 - 213.

Cokendolpher J.C. & Polyak V.J., 1996. – Biology of the caves at Sinkhole Flat, Eddy County, New Mexico. *Journal of Cave and Karst Studies*, 58(3): 181 - 192.

Correa C.M.A., Rabelo L.M., Audino L.D., Ferreira R.L., Vaz-de-Mello F.Z. & Grossi P.C., 2022. – Scarabs in the dark: occurrence of Scarabaeoidea beetles (Insecta: Coleoptera) in Brazilian caves. *Revista Brasileira de Entomologia*, 66(4), e20220018: 1 - 5. https://doi.org/10.1590/1806-9665-RBENT-2022-0018.

Costa-Silva V., Strümpher W.P. & Vaz-de-Mello F.Z., 2021. – Review of the Brazilian species of *Omorgus* Erichson, 1847 (Coleoptera: Trogidae: Omorginae). *Journal of Natural History*, 54(31 - 32): 1993 - 2024. https://doi.org/10.1080/00222933.2020.1833999

Crawford R.L. & Veni G., 1981. – Preliminary report on the biology of Sorcerer's Cave, Texas (U.S.A.). In: Beck B.F. (ed.), *Proceedings of the Eighth International Congress of Speleology. Volume I.* National Speleological Society, Bowling Green, Kentucky, USA. pp. 298 - 300.

Dandurand G., Duranthon F., Jarry M., Stratford D.J. & Bruxelles L., 2019. – Biogenic corrosion caused by bats in Drotsky's Cave (the Gcwihaba Hills, NW Botswana). *Geomorphology*, 327: 284 - 296. https://doi.org/10.1016/j.geomorph.2018.10.027.

Deharveng L. & Bedos A., 2018. – Diversity of terrestrial invertebrates in subterranean habitats. In: Moldovan O.T., Kováč Ľ. & Halse, S. (eds.), *Cave Ecology*. Ecological Studies 235: 107 - 172. Springer Nature, Cham, Switzerland. https://doi.org/10.1007/978-3-319-98852-8_7.

Ferreira R.L. & Martins P.R., 1999. – Trophic structure and natural history of bat guano invertebrate communities, with special reference to Brazilian caves. *Tropical Zoology*, 12(2): 231 - 252. https://doi.org/10.1080/03946975.1999.10539391.

Frey J., 2009. – Distinguishing range expansions from previously undocumented populations using background data from museum records. *Diversity and Distributions*, 15(2): 183 - 187. https://doi.org/10.1111/j.1472-4642.2008.00552.x.

Gardner J.E., 1986. – Invertebrate fauna from Missouri caves and springs. *Missouri Department of Conservation, Natural History Series*, 3: 1 - 72.

Gianizella S.L. & Prado A.P., 1999. – Ocorrência e sazonalidade de *Omorgus* (*Omorgus*) *suberosus* (Fabr.) (Trogidae: Coleoptera) em esterco de aves poedeiras, em Monte Mor, SP. *Anais da Sociedade Entomológica do Brasil*, 28(4): 749 - 751. https://doi.org/10.1590/S0301-80591999000400019.

Gnaspini P. & Trajano E., 2000. – Guano communities in tropical caves. In: Wilkens H., Culver D.C. & Humphreys W.F. (eds.), *Ecosystems of the World. 30. Subterranean Ecosystems.* Elsevier, Amsterdam. pp. 251-268.

Gómez B., Rodrígues-López M.E. & Sánchez-Hernández G., 2022. – Atracción de *Omorgus* (*Omorgus*) *suberosus* (Fabricius, 1775) (Coleoptera: Trogidae) a excretas de mamíferos carnívoros. *Revista Chilena de Entomología*, 48(2): 321 - 327. https://doi.org/10.35249/rche.48.2.22.14.

Hamilton-Smith E., 1967. – The Arthropoda of Australian caves. *Journal of the Australian Entomological Society*, 6(2): 103 - 118. https://doi.org/10.1111/j.1440-6055.1967.tb02123.x.

Hamilton-Smith E., Holland E., Mott K. & Spate A., 1989. – *Cutta Cutta Caves Nature Park – Draft plan of management*. Unpublished report, Conservation Commission of the Northern Territory. vi + 79 pp.

Hicks E.A., 1959. – *Check-list and Bibliography on the Occurrence of Insects in Birds' Nests.* Iowa State College Press, Ames, Iowa. 681 pp.

Horenstein M.B. & Linhares A.X., 2011. – Seasonal composition and temporal succession of necrophagous and predator beetles on pig carrion in central Argentina. *Medical and Veterinary Entomology*, 25(4): 395 - 401. https://doi.org/10.1111/j.1365-2915.2011.00969.x.

Houston T.F., Zhang J. & Hanich B.P., 2010. – Diet of the flightless trogid beetle *Omorgus rotundulus* (Haaf) (Coleoptera: Trogidae) in the Little Sandy Desert of Western Australia. *Australian Entomologist*, 36(4): 207 - 212.

Howarth F.G. & Moldovan O.T., 2018. – Where cave animals live. In: Moldovan O.T., Kováč Ľ. & Halse, S. (eds.), *Cave Ecology*. Ecological Studies 235: 23 - 37. Springer Nature, Cham, Switzerland. https://doi.org/10.1007/978-3-319-98852-8_3.

Huchet J.-B. & Da Costa-Silva V., 2018. – A new species of *Polynoncus* Burmeister, 1876 from Brazil (Coleoptera: Trogidae). *Zootaxa*, 4524(5): 553 - 566. https://doi.org/10.11646/zootaxa.4524.5.3.

Huchet J.-B., Pereira G., Gomy Y., Philips T.K., Alatorre-Bracamontes C.E., Vásquez-Bolaños M. & Mansilla J., 2013. – Archaeoentomological study of a pre-Columbian funerary bundle (mortuary cave of Candelaria, Coahuila, Mexico). *Annales de la Société Entomologique de France (N.S.)*, 49(3): 277 - 290. https://doi.org/10.1080/00379271.2013.845474.

Hughes J. & Vogler A.P., 2006. – Gene expression in the gut of keratin-feeding clothes moths (*Tineola*) and keratin beetles (*Trox*) revealed by subtracted cDNA libraries. *Insect Biochemistry and Molecular Biology*, 36(7): 584 - 592. https://doi.org/10.1016/j.ibmb.2006.04.007.

Jackson D.S. & Diéguez M., 2023. – Primer registro de *Polynoncus bullatus* (Curtis, 1844) (Coleoptera: Trogidae) alimentándose en heces de gato montés, *Leopardus* sp. (Carnivora: Felidae), en Chile central. *Revista Chilena de Entomología*, 49(1): 145 - 149. https://doi.org/10.35249/rche.49.1.23.16.

Kočárek P., 2003. – Decomposition and Coleoptera succession on exposed carrion of small mammal in Opava, the Czech Republic. *European Journal of Soil Biology*, 39(1): 31 - 45. https://doi.org/10.1016/S1164-5563(02)00007-9.

Kohls G.M. & Jellison W.L., 1948. – Ectoparasites and other arthropods occurring in Texas bat caves. *Bulletin of the National Speleological Society*, 10: 116 - 117.

Krell F.-T., Korb J. & Walter P., 2003. – The beetle fauna of hyaena latrines: coprocenoses consisting of necrophagous beetles (Coleoptera Trogidae Scarabaeidae). *Tropical Zoology*, 16(2): 145 - 152. https://doi.org/10.1080/03946975.2003.10531191.

Kunz T.H., Braun de Torrez E., Bauer D., Lobova T. & Fleming T.H., 2011. – Ecosystem services provided by bats. *Annals of the New York Academy of Sciences*, 1223(1): 1 - 38. https://doi.org/10.1111/j.1749-6632.2011.06004.x.

Leefmans S., 1932. – Biologische gegevens van een in grotten levenden *Trox* uit Zuid-Celebes (*Trox costatus* Wied. var.) (Lamellicornia, Scarabaeidae, Trogini). *Tijdschrift voor Entomologie*, 75: 36 - 43.

Loomis H.F., 1922. – New species of the coleopterous genus *Trox*. *Journal of the Washington Academy of Sciences*, 12(5): 132 - 136.

Lopes W.D.Z., da Costa F.H., Lopes W.C.Z., Balieiro J.C. de C., Soares V.E. & do Prado Â.P., 2007. – *Omorgus* (*Omorgus*) *suberosus* (Fabricius) (Coleoptera: Trogidae) em esterco de galinhas poedeiras de São João da Boa Vista, SP, Brasil. *Arquivos do Instituto Biológico*, 74(3): 227 - 232. https://doi.org/10.1590/1808-1657v74p2272007.

Majka C.G., Klimaszewski J. & Lauff R.F., 2006. – New Coleoptera records from owl nests in Nova Scotia, Canada. *Zootaxa*, 1194: 33 - 47. https://doi.org/10.11646/zootaxa.1194.1.2.

Marais W. & Durand J.F., 2006. – *Preliminary Study of the Terrestrial Arthropods Associated with Bat Guano in Caves of the Cradle of Humankind World Heritage Site.* Unpublished BSc Hons project, University of Johannesburg, South Africa. 18 pp.

Mazebedi R. & Hesselberg T., 2020. – A preliminary survey of the abundance, diversity and distribution of terrestrial macroinvertebrates of Gcwihaba cave, northwest Botswana. *Subterranean Biology*, 35: 49 - 63. https://doi.org/10.3897/subtbiol.35.51445.

McClure H.E., Lim B.-L. & Winn S.E., 1967. – Fauna of the Dark Cave, Batu Caves, Kuala Lumpur, Malaysia. *Pacific Insects*, 9(3): 399 - 428.

Miquel M.E., 2019. – On the distribution of *Omorgus suberosus* (Coleoptera: Trogidae) and its presence in the Philippines. *Entomofauna*, 40(1): 183 - 191.

Moctezuma V. & Halffter G., 2022. – First attraction record of *Trox plicatus* Robinson, 1940 (Coleoptera: Trogidae) to feces of bobcat *Lynx rufus* Schreber, 1777 (Carnivora: Felidae). *Revista Chilena de Entomología*, 48(4): 725-729. https://doi.org/10.35249/rche.48.4.22.05.

Moulds T., 2004. – Review of Australian cave guano ecosystems with a checklist of guano invertebrates. *Proceedings of the Linnean Society of New South Wales*, 125: 1 - 42.

Moulds T. & Bannink P., 2012. – Preliminary notes on the cavernicolous arthropod fauna of Judbarra/Gregory Karst Area, northern Australia. *Helictite*, 41: 75 - 85.

Muñiz Vélez R., 2001. – Restos de insectos antiguos recuperados en la cueva "La Chagüera" del Estado de Morelos, México. *Acta Zoologica Mexicana (n.s.)*, 83, 115 - 125.

Payne J.A. & Crossley D.A., 1966. – *Animal Species Associated with Pig Carrion.* Unpublished report ORNL-TM-1432, Oak Ridge National Laboratory, Oak Ridge, Tennessee, USA. i-iii + 1 - 70 pp.

Peck S.B., 2009. – The beetles of Barbados, West Indies (Insecta: Coleoptera): diversity, distribution and faunal structure. *Insecta Mundi*, 73: 1-51.

Peck S.B. & Christiansen K., 1990. – Evolution and zoogeography of the invertebrate cave faunas of the Driftless Area of the Upper Mississippi River Valley of Iowa, Minnesota, Wisconsin, and Illinois, U.S.A. *Canadian Journal of Zoology*, 68(1): 73-88. https://doi.org/10.1139/z90-012.

Pérez T., Morales M.J. & López-Colón J.I., 2011. – *Trox (Trox) scaber* (Linnaeus, 1767) (Coleoptera, Trogidae) capturado en una cavidad de Granada. *Boletín de la Sociedad Andaluza de Entomología*, 17: 18-23.

Petrovitz R., 1969. – Ergänzungen und Berichtigungen zu: Ad. Horion / Faunistik der mitteleuropäischen Käfer, VI/1958, Lamellicornia. II Teil. *Zeitschrift der Arbeitsgemeinschaft der Österreichischen Entomologen*, 21: 104-105.

Petrovitz R., 1975. – Zwei neue *Trox*-Arten (Coleoptera: Scarabaeidae). *Opuscula Zoologica*, 132: 1-3.

Pittino R., 2005. – Four new Asian species of the genus *Omorgus* Erichson, 1847 (Coloeptera [sic], Scarabaeoidea, Trogidae). *Kogane*, 6: 71-79.

Pittino R. & Bezděk A., 2016. – Family Trogidae W.S. MacLeay, 1819. In: Löbl I. & Löbl D. (eds.), *Catalogue of Palaearctic Coleoptera. Volume 3. Scarabaeoidea – Scirtoidea – Dascilloidea – Buprestoidea – Byrrhoidea. Revised and Updated Edition*. Brill, Leiden, The Netherlands. pp. 53-58. https://doi.org/10.1163/9789004309142

Ramírez-Fráncel L.A., García-Herrer L.V., Losada-Prado S., Reinoso-Flórez G., Sánchez-Hernández A., Estrada-Villegas S., Lim B.K. & Guevara G., 2022. – Bats and their vital ecosystem services: a global review. *Integrative Zoology*, 17(1): 2-23 + Suppl. Tables S1-S5 + Suppl. Fig. S5b. https://doi.org/10.1111/1749-4877.12552.

Reeves W.K., Jensen J.B. & Ozier J.C., 2000. – New faunal and fungal records from caves in Georgia, USA. *Journal of Cave and Karst Studies*, 62(3): 169-179.

Richards A.M., 1971 – An ecological study of the cavernicolous fauna of the Nullarbor Plain Southern Australia. *Journal of Zoology, London*, 164(1): 1-60 + Plates 1-6. https://doi.org/10.1111/j.1469-7998.1971.tb01297.x.

Risbec J., 1946. – Action de prédateurs et de parasites sur *Schistocerca gregaria* au Sénégal. *Bulletin Semestriel de l'Office National Anti-Acridien*, 2: 5-16.

Robinson M., 1941. – Notes on some rare Scarabaeidae with the description of one new species. (Coleoptera). *Entomological News*, 52: 227-232.

Roffey J., 1958. – Observations on the biology of *Trox procerus* Har. (Coleoptera, Trogidae), a predator of eggs of the desert locust, *Schistocerca gregaria* (Forsk.). *Bulletin of Entomological Research*, 49(3): 449-465 + Plate XVI. https://doi.org/10.1017/S0007485300053773.

Rosano-Hernández M.C. & Deloya C., 2002. – Interacción entre trogidos (Coleoptera: Trogidae) y tortugas marinas (Reptilia: Cheloniidae) en el Pacifico Mexicano. *Acta Zoológica Mexicana (N.S.)*, 87: 29-46.

Scholtz C.H., 1980. – Monograph of the genus *Trox* F. (Coleoptera: Trogidae) of subsaharan Africa. *Cimbebasia Memoir*, 4: 1-104.

Scholtz C.H., 1986a. – Phylogeny and systematics of the Trogidae (Coleoptera: Scarabaeoidea). *Systematic Entomology*, 11(3): 355-363. https://doi.org/10.1111/j.1365-3113.1986.tb00186.x.

Scholtz C.H., 1986b. – Revision of the genus *Trox* Fabricius (Coleoptera: Trogidae) of the Australasian Region. *Australian Journal of Zoology, Supplementary Series*, 34(125): 1-99. https://doi.org/10.1071/AJZS125.

Scholtz C.H. & Caveney S., 1988. – Adaptations in trogid carrion beetles to extremely arid conditions. *Journal of Arid Environments*, 15(2): 179-191. https://doi.org/10.1016/S0140-1963(18)30991-1.

Scholtz C.H. & Caveney S., 1992. – Daily biphasic behaviour in keratin-feeding desert trogid beetles in relation to climate. *Ecological Entomology*, 17(2): 155-159. https://doi.org/10.1111/j.1365-2311.1992.tb01173.x.

Scholtz C.H. & Chown S.L., 1995. – The evolution of habitat use and diet in the Scarabaeoidea: a phylogenetic approach. In: Pakaluk J & Ślipiński SA (eds.), *Biology, Phylogeny, and Classification of Coleoptera: Papers Celebrating the 80th Birthday of Roy A. Crowson.* Muzeum i Instytut Zoologii PAN, Warsaw. pp. 355-374.

Seamark E.C.J. & Pretorius M., 2018. – Exploratory visit to Gcwihaba Cave, Botswana. *African Bat Conservation News*, 47: 5-6.

Sharratt N.J, Picker M.D. & Samways M.J., 2000. – The invertebrate fauna of the sandstone caves of the Cape Peninsula (South Africa): patterns of endemism and conservation priorities. *Biodiversity and Conservation*, 9(1): 107-143. https://doi.org/10.1023/A:1008968518058.

Slay M.E., Skelley P.E. & Taylor S.J., 2012. – New records of *Onthophagus cavernicollis* Howden and Cartwright (Coleoptera: Scarabaeidae) from Ozark caves, with a review of scarabaeoids reported from North American caves. *Coleopterists Bulletin*, 66(3): 187-199. https://doi.org/10.1649/072.066.0302.

Strümpher W.P., Farrell J. & Scholtz C.H., 2014a. – Trogidae (Coleoptera: Scarabaeoidea) in forensic entomology: occurrence of known and new species in Queensland, Australia. *Austral Entomology*, 53(4): 368-372. https://doi.org/10.1111/aen.12084.

Strümpher W.P. & Kalawate A.S., 2023. – *Omorgus* (*Omorgus*) *khandesh* (Coleoptera: Scarabaeoidea: Trogidae), a new species from India, along with an annotated catalogue of the Oriental and Palearctic species of the subgenus *Omorgus* Erichson, 1847. *Zootaxa*, 5231(5): 501-522. https://doi.org/10.11646/zootaxa.5231.5.1

Strümpher W.P., Sole C.L., Villet M.H. & Scholtz C.H., 2014b. – Phylogeny of the family Trogidae (Coleoptera: Scarabaeoidea) inferred from mitochondrial and nuclear ribosomal DNA sequence data. *Systematic Entomology*, 39(3): 548–562 + Suppl. Figs S1–S2 + Suppl. Tables S1–S4. https://doi.org/10.1111/syen.12074.

Sugiura S. & Ikeda H., 2014. – Keratin decomposition by trogid beetles: evidence from feeding experiment and isotope analysis. *Naturwissenschaften*, 101(3): 187-196. https://doi.org/10.1007/s00114-013-1137-z.

Tinaut A., Andrés V.S. & Ojeda M.D.L., 2008. – Estudio de la fauna cavernícola del Parque Natural Sierra Norte de Sevilla. In: Menor A. & Cuenca I. (eds.), *Investigación Científica y Conservación en el Parque Natural Sierra Norte de Sevilla.* Consejería de Medio Ambiente, Junta de Andalucía, Seville. pp. 116-133.

Tocco C., Balmer J.P. & Villet M.H., 2018. – Trophic preference of southern African dung beetles (Scarabaeoidea: Scarabaeinae and Aphodiinae) and its influence on bioindicator surveys. *African Journal of Ecology*, 56(4): 938-948. https://doi.org/10.1111/aje.12523.

Tweet J.S., Santucci V.L. & Hunt A.P., 2012. – An inventory of packrat (*Neotoma* spp.) middens in National Park Service areas. In: Hunt A.P., Milàn J., Lucas S.G. & Spielmann J.A. (eds)., *Vertebrate Coprolites*. *New Mexico Museum of Natural History & Science, Bulletin*, 57: 355-368.

Van Cakenberghe V., Gembu Tungaluna G.-C., Musaba Akawa P., Seamark E. & Verheyen E., 2017. – The bats of the Congo and of Rwanda and Burundi revisited (Mammalia:

Chiroptera). *European Journal of Taxonomy*, 382: 1-327. https://doi.org/10.5852/ejt.2017.382.

Van Emden F.I., 1948. – A *Trox* larva feeding on locust eggs in Somalia. *Proceedings of the Royal Entomological Society of London, Series B, Taxonomy*, 17(11-12): 145-148. https://doi.org/10.1111/j.1365-3113.1948.tb00881.x.

Vaurie P., 1955. – A revision of the genus *Trox* in North America (Coleoptera, Scarabaeidae). *Bulletin of the American Museum of Natural History*, 106(1): 1-89. https://doi.org/2246/427.

Vaurie P., 1962. – A revision of the genus *Trox* in South America (Coleoptera, Scarabaeidae). *Bulletin of the American Museum of Natural History*, 124(4): 105-167. https://doi.org/2246/1210.

Young O.P., 2006. – Survival and reproduction of *Trox suberosus* F. (Coleoptera: Trogidae) on insect cadavers, cow dung, and mushroom. *Journal of Entomological Science*, 41(3): 271-276. https://doi.org/10.18474/0749-8004-41.3.271.

Young O.P. & Hamm J.J., 1985. – The effect of the consumption of NPV-infected dead fall armyworm larvae on the longevity of two species of scavenger beetles. *Journal of Entomological Science*, 20(1): 90-94. https://doi.org/10.18474/0749-8004-20.1.90.

Zidek J., 2013. – Checklist and bibliography of the Trogidae (Coleoptera: Scarabaeoidea). *Insecta Mundi*, 314: 1-38. https://doi.org/10.5281/zenodo.10091092.

Zunino M., 1991. – Food relocation behaviour: a multivalent strategy of Coleoptera. In: Zunino M., Bellés X. & Blas M. (eds.), *Advances in Coleopterology*. Asociación Europea de Coleopterología, Barcelona. pp. 297-314.

Author contributions [1]

Project initiator. – WPS
Publisher correspondence. – RS
Writing the article. – WPS & RS
Article proofreading. – RS
Bibliographic work. – RS & WPS
Material study. – WPS
Author of the figures. – WPS (Fig. 1A–E)

[1] **RS** = Riaan Stals. – **WPS** = Werner Strümpher.

Résumé

Strümpher W. P. & Stals R., 2025. – Liste mondiale des Trogidae (Coleoptera : Scarabaeoidea) associés aux grottes et au guano de chauve-souris, et extension supplémentaire de l'aire de répartition d'*Omorgus lindemannae* (Petrovitz). *Faunitaxys*, 13(09): 1–11.

Les Trogidae sont assez souvent associés aux dépôts de guano provenant des chauves-souris perchées dans les grottes, et moins fréquemment au guano de chauve-souris dans les creux des arbres. Les Trogidae peuvent également être présents dans les grottes sans aucune association apparente avec le guano de chauve-souris. Comme un nombre assez important de rapports sur le comportement susmentionné est dispersé dans une littérature souvent obscure, nous avons compilé et commenté une liste d'espèces de Trogidae - dans le monde entier - qui ont été observées soit dans des grottes, soit dans du guano de chauve-souris à l'intérieur ou à l'extérieur des grottes. Nous signalons 20 espèces nommées confirmées comme cavernicoles et/ou associées aux excréments de chauve-souris ; et un nombre inconnu d'espèces jusqu'ici identifiées uniquement au niveau du genre. Nous classons par tableau les espèces potentiellement cavernicoles pour lesquelles une confirmation d'une association avec une grotte est requise. Nous considérons la présence dans les grottes de la moitié de ces espèces nommées comme accidentelle ou fortuite, 9 ou 10 espèces comme troglophiles et trois espèces comme à la fois troglophiles et guanophiles de chauve-souris. Une espèce ne semble pas être troglophile, mais tout de même un guanobionte de chauve-souris ; il s'agit peut-être d'un nouveau mode de vie. Aucun Trogidae n'est connu pour être troglomorphe ou troglobitique. Pour trois espèces nommées, nous présentons la première preuve publiée d'un mode de vie prétendument cavernicole. Nous proposons que *Trox perrisii* Fairmaire soit exclu d'une compilation telle que la nôtre. Nous introduisons notre travail par un aperçu critique des habitudes alimentaires des Trogidae : ils ne se nourrissent pas nécessairement de matières kératiniques, comme on le suppose généralement. Nous signalons de nouvelles localités d'Afrique australe qui étendent l'aire de répartition *d'Omorgus lindemannae* (Petrovitz). Des photos en couleur de chacun des genres et sous-genres répertoriés accompagnent le texte.

Mots-clés. – Coleoptera, Scarabaeoidea, Trogidae, Trox, *Phoberus*, *Afromorgus*, *Haroldomorgus*, *Polynoncus*, Chiroptera, cavernicole, arbre creux, distribution, nouvelle mention, coléoptère de la kératine.

Derniers articles publiés

Lourenço W. R. & Velten J., 2025. – One more new species for the genus *Cretaceoushormiops* Lourenço, 2018 from Cretaceous Burmite (Scorpiones: Protoischnuridae). *Faunitaxys*, 13(02): 1 – 6. https://doi.org/10.57800/faunitaxys-13(02)

Lourenço W. R. & Velten J., 2025. – A new species for the genus *Archaeoananteroides* Lourenço, 2016, fossil scorpion from Burmite (Scorpiones: Buthoidea: Buthidae). *Faunitaxys*, 13(03): 1 – 6. https://doi.org/10.57800/faunitaxys-13(03)

Lourenço W. R. & Ythier E., 2025. – A new cave species of *Isometrus* Ehrenberg 1828 from Myanmar (Scorpiones: Buthidae). *Faunitaxys*, 13(04): 1 – 6. https://doi.org/10.57800/faunitaxys-13(04)

Platia G. & Pedroni G., 2025. – Five new species and new records of click beetles from Saudi Arabia with an updated catalogue (Coleoptera, Elateridae). *Faunitaxys*, 13(05): 1 – 12. https://doi.org/10.57800/faunitaxys-13(05)

Háva J. & Hodeček J., 2025. – Two additional new species of *Cryptorhopalum* (Coleoptera: Dermestidae: Megatominae) from the Dominican Republic. *Faunitaxys*, 13(06): 1 – 5. https://doi.org/10.57800/faunitaxys-13(06)

Vitali F., 2025. – The genus *Epicasta* Thomson, 1864 and the limits of the morphological systematics in the study of Lamiinae (Coleoptera Cerambycidae). *Faunitaxys*, 13(07): 1 – 5. https://doi.org/10.57800/faunitaxys-13(07)

Ythier E., Sadine S. E., Alioua Y. & Lourenço W. R., 2025. – A new species of *Androctonus* Ehrenberg, 1828 from the Tassili n'Ajjer, Algeria (Scorpiones: Buthidae). *Faunitaxys*, 13(08): 1 – 8. https://doi.org/10.57800/faunitaxys-13(08)

Faunitaxys

Volume 13, Numéro 09, Février 2025

SOMMAIRE

Liste mondiale des Trogidae (Coleoptera : Scarabaeoidea) associés aux grottes et au guano de chauve-souris, et extension supplémentaire de l'aire de répartition d'*Omorgus lindemannae* (Petrovitz).

Werner P. Strümpher & Riaan Stals . . . . . 1 – 11

CONTENTS

A world list of known cave- and bat guano-associated Trogidae (Coleoptera: Scarabaeoidea), and further range extension of *Omorgus lindemannae* (Petrovitz).

Werner P. Strümpher & Riaan Stals . . . . . 1 – 11

Illustration de la couverture :

Bushveld Horseshoe Bat (*Rhinolophus simulator* K. Andersen) and its reflection, coming in to drink water. Limpopo Province, South Africa.

Crédits:

Werner P Strümpher : Fig. 1A-E.
Huchet & **Costa-Silva** (2018) : Fig. 1F (used with permission).
Ruth Müller : couverture.

Publié par l'Association Française de Cartographie de la Faune et de la Flore (AFCFF)